

Standard Operating Procedure for General Shipboard Scientific Operations

LG100

Revision 04, May 2005

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STANDARD OPERATING PROCEDURE FOR
GENERAL SHIPBOARD SCIENTIFIC OPERATIONS

1.0 SAFETY AND TRAINING

- 1.1 All EPA, contractor, and grantee staff participating in the surveys must be fully trained in onboard safety requirements and any scientific functions for which they are responsible. Survey scientists involved in sample or data collection also must be trained to use the equipment and procedures specified in the manual, *Sampling and Analytical Procedures for GLNPO's Water Quality Survey*.
- 1.2 GLNPO's Ship Safety Officer is responsible for overseeing all safety issues onboard the *R/V Lake Guardian*. In addition, the Ship Safety Officer is responsible for ensuring avenues of communication to and from the ship. This is primarily accomplished through electronic mail, cell phones and facsimile. An emergency phone number via satellite is made available during cruises to allow for rapid communication in cases of emergencies.
- 1.3 Training responsibilities vary according to specialty. GLNPO is responsible for providing all safety training and for training survey scientists in the use of the Rosette sampling device, the collection of onboard measurements using the SeaBird, and the use of specific instruments and techniques for measurement of other physical parameters. The GLAS contractor and biology grantee are responsible for training their staff in the collection and analysis of biological and nutrient parameters of interest. In addition, the GLAS contract and the grant agreement specify minimum skills (i.e., education and experience) required of the analysts performing work under this contract.
- 1.4 Specific training requirements will include some or all of the following courses, depending on the specific responsibilities of the survey participant(s).
 - 1) 24-hour Laboratory Safety Course/4-hour Laboratory Safety Refresher Course (required for all government, contractor, and grantee survey scientists working in the ship laboratory)
 - 2) First Aid, CPR, EMT training for all designated 'first responders' (Chief Scientist, Shift Supervisor, First Mate, and Second Mate)
 - 3) Fire Fighting (required for the contractor-provided ship operating personnel)
 - 4) Powered Industrial Trucks/fork lifts (required for the contractor provided ship operating personnel)
 - 5) GLNPO Chemical Hygiene Plan
 - 6) Safety Orientation Video (required for every individual that participants in cruises, regardless of responsibility)
 - 7) Boat Handling and Seamanship (required of the contractor-provided ship operating personnel).
- 1.5 Refer to GLNPO's *Health, Safety, and Environmental Compliance Manual* (May 1997 or as amended) for specific details on applicable personal health and safety issues, instrumental, chemical, and waste handling procedures, and accident prevention. This applies to all EPA personnel, EPA contractors, EPA grantees, or federal, state, or local government agencies, and persons who operate or are passengers onboard US EPA GLNPO vessels during all activities and surveys.
- 1.6 During sampling, caution, common sense, and good judgement should dictate appropriate safety gear to be worn in any given situation on deck. Hardhats, gloves, and steel-toed shoes must be worn in working conditions where there is a possibility of injury to the head, hands, or feet; however, if in doubt, please ask the Chemical Hygiene Officer. Work vests must be worn while working on the fantail and Rosette deck.
- 1.7 Collecting samples in cold weather, especially around cold water bodies, carries the risk of hypothermia and frostbite. Sampling team members should wear adequate clothing for protection in cold weather. In order to prevent slipping hazards, sand should be applied. A de-icer may be applied while the ship is underway and rinsed

off the deck prior to reaching a station. Sand may then be applied. For specific information regarding sampling during cold conditions, please refer to the *Standard Operating Procedures for Winter Operations* (available from GLNPO as Appendix F in the March 2001 version of this manual). Collecting samples in extremely hot and humid weather carries the risk of dehydration and heat stroke. Sampling team members should carry an adequate supply of water or other liquids for protection against dehydration in hot weather.

2.0 ROLES AND RESPONSIBILITIES

- 2.1 While surveys are in progress, there are dual lines of leadership and authority. Ultimate responsibility and authority for all scientific and technical operations lies with GLNPO's Chief Scientist. However, the ship Captain has ultimate responsibility for all maritime and safety operations onboard ship, and the Captain has the authority to halt all scientific and technical operations when s/he considers it necessary to ensure the safety of all passengers and crew. In addition, contractors and grantees participating in survey are responsible for reporting to their own management as well as to EPA scientists who provide them with site-specific instruction regarding sample collection, handling, and/or analysis. This instruction differs from technical direction in that it does not increase the level of effort or cost of existing tasking and focuses on the minor technical details (such as when to drop the winch) rather than significant instructions. Table 3-1 summarizes the roles and responsibilities of key *technical* staff involved in Water Quality Survey activities onboard the *R/V Lake Guardian*.

**Table 2-1:
Roles, Responsibilities, Authority, and Lines of Communication
Onboard the *R/V Lake Guardian* During Water Quality Surveys**

Organization	Role	Responsibility	Authority	Lines of Communication
EPA	Chief Scientist	<ul style="list-style-type: none"> • All scientific and technical operations onboard ship during the surveys • Ensuring that all requirements of this QAPP are followed throughout the survey • Ensuring that all EPA, contractor, and grantee staff adhere to applicable SOPs and collect and document all required data at all stations • Ensuring adherence to all ship requirements (safety, etc) during surveys • Ensuring the performance and/or participating in technical systems audits • Calls Science Meeting after ship sails 	<ul style="list-style-type: none"> • Complete authority for all scientific and technical operations 	<ul style="list-style-type: none"> • Communicates with Captain or senior officer on bridge • Communicates with EPA, contractor, and grantee staff • Reports to Survey Team Lead or WQI Branch Chief when in dock
EPA	Shift Supervisor	<ul style="list-style-type: none"> • Back up to the Chief Scientist (see above responsibilities) • All scientific and technical operations when Chief Scientist is off duty 	<ul style="list-style-type: none"> • Complete authority for all scientific and technical operations when Chief Scientist is off duty • May be over-ruled by Chief Scientist 	<ul style="list-style-type: none"> • Communicates with Captain or senior officer on bridge • Communicates direction to all EPA, contractor, and grantee staff during his shift • Reports to Chief Scientist while onboard ship
Ship Operations Contractor	Captain	<ul style="list-style-type: none"> • Ultimate responsibility of ship safety • Ensuring ship arrives at designated sites on schedule established prior to cruise • Oversight of all ship contractor staff • Ensuring all survey 	<ul style="list-style-type: none"> • Complete authority to halt scientific and technical operations when necessary to protect safety of crew and 	<ul style="list-style-type: none"> • Communicates direction to all ship operations contractor staff • Communicates with Chief Scientist for site-specific instructions • Contractually reports to Ship Operations Project Officer and Contracting

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Organization	Role	Responsibility	Authority	Lines of Communication
		participants have practiced ship safety drill <ul style="list-style-type: none"> Collecting and documenting all bridge data as described in this QAPP and applicable SOPs 	passengers	Officer
	First Mate	<ul style="list-style-type: none"> Back up to Captain when off duty (see above responsibilities) 	<ul style="list-style-type: none"> Same as above when Captain is off duty 	<ul style="list-style-type: none"> Reports to Captain Same as above when Captain is off duty
	Marine Technicians	<ul style="list-style-type: none"> Assist GLNPO scientists with sample collection activities Operate ship's mechanical sampling equipment, such as winches Assist GLNPO scientist with "board chemistry" analyses in wet chem lab Understanding and implementing all QA/QC requirements described in this QAPP 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Supervised by Captain Receive site-specific instruction from Chief Scientist/Shift Supervisor
Grantee	Biologist(s)	<ul style="list-style-type: none"> All on board sampling, sample handling, labeling, and sample preservation activities related to zooplankton tows and benthos grabs in accordance with applicable SOPs All on board sample handling, labeling, and preservation activities related to phytoplankton and chlorophyll a in accordance with applicable SOPs Assistance with Rosette sampling when requested by GLNPO staff Understanding and implementing all QA/QC requirements described in this QAPP Informing Chief 	<ul style="list-style-type: none"> Senior biologist has authority over second shift biologist 	<ul style="list-style-type: none"> Receives site-specific instruction from Chief Scientist/Shift Supervisor Communicates through the Biology Technical Lead and Grants Officer

Organization	Role	Responsibility	Authority	Lines of Communication
		Scientist/Shift Supervisor of technical or QA issues <ul style="list-style-type: none"> Informing technical staff of changes in required procedures 		
GLAS Contractor	Chemist(s)	<ul style="list-style-type: none"> Assisting with Rosette sampling when requested by GLNPO staff Adhering to all applicable SOPs to conduct all on board sample handling, preservation, and filtration activities related to nutrient and other chemical or physical analyses performed at the land-based laboratory by the GLAS contractor Understanding and implementing all QA/QC requirements described in this QAPP. Informing Chief Scientist/Shift Supervisor of technical or QA issues Informing technical staff of changes in required procedures 	<ul style="list-style-type: none"> Senior chemist has authority over second shift chemist 	<ul style="list-style-type: none"> Receives site-specific instruction from Chief Scientist/Shift Supervisor Communicates through the Limnology Technical Lead and Project Officer
Public Health Service/ Region 5	Chemical Hygiene Officer	<ul style="list-style-type: none"> Responsible for all aspects of management of chemicals and chemical wastes Manages on board storage and control of chemicals Disposes of laboratory chemical wastes Verifies all onboard staff have turned in sealed medical history questionnaire Verifies all onboard staff have taken the laboratory safety course Serves as back-up to Captain in ensuring all survey participants try on the survival suits Calls Safety Meeting after ship sails 	<ul style="list-style-type: none"> Require changes in chemical handling, management or disposal operations Require changes in food management and handling operations 	<ul style="list-style-type: none"> Reports to Jim Finn of Region 5 through Public Health Service Takes survey-specific direction from Ship Operations Manager and Chief Scientist/Shift Supervisor

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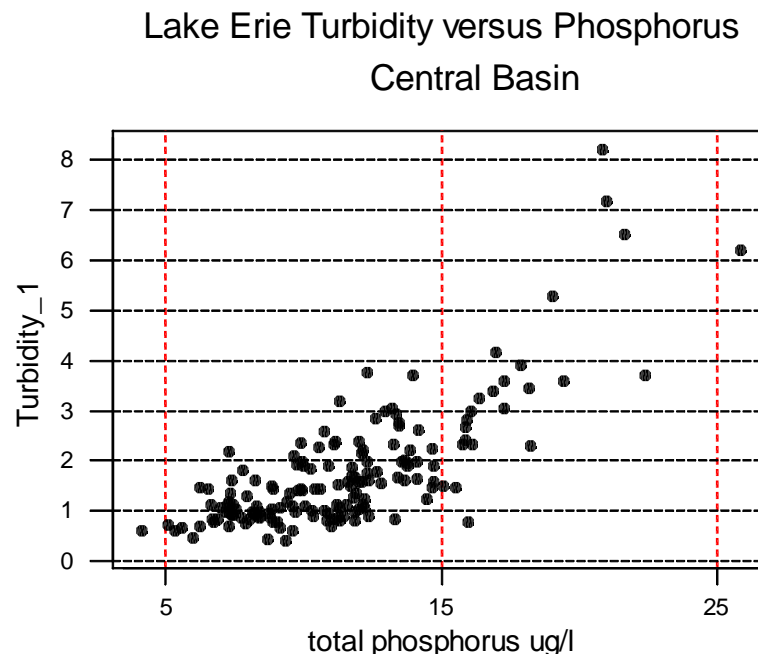
Organization	Role	Responsibility	Authority	Lines of Communication
		<ul style="list-style-type: none">Acts as contact person to locate reagents onboard when survey staff need them		

3.0 SAMPLING LOCATION DETERMINATION

- 3.1 Sampling locations are pre-determined and are provided in Appendix A, *Great Lakes Maps*. Please note that in the event that a sampling station needs to be changed, GLNPO follows the station location change procedure described in Section 7. When the *R/V Lake Guardian* arrives on station, the Captain notifies survey participants of the station name and ship time and sample collection commences. When the Rosette sampler is lowered into the water, the Chief Scientist and marine technicians monitor the sampler to maintain a vertical cable. If the cable moves off vertical, the Chief Scientist and the ship Captain coordinate in an attempt to maneuver the ship to maintain a vertical cable. The ship GPS system provides a constant indication of distance off station. The Captain will notify the Chief Scientist/Shift Supervisor when the vessel drifts a significant distance from the station. The Captain typically notifies the Chief Scientist at one-quarter nautical mile off station and absolutely at one-half nautical mile off station. Depending on the number of samples still to be collected, the Chief Scientist may direct the Captain to return to station. Typically, it is easiest to make this assessment between sampling activities. If the planned sampling activities require more than several hours, the Captain will anchor the vessel on station. For benthic sampling at near-shore stations, the vessel should stay within one-quarter nautical mile of the station locations because sediment characteristics and associated biota can vary at greater distances.

For Lake Erie surveys, sampling locations sometimes should be revisited due to windy conditions that can stir up the lake bottom. The Chief Scientist should review the results of turbidity measures for Lake Erie to determine if another sampling event should be conducted on the return trip through Lake Erie. If the average turbidity is more than 4 NTU for the Central basin stations on Lake Erie, the results may be artifacts of the sediment resuspension and may not accurately reflect the conditions of the water column (see Figure 1). In these cases, the Chief Scientist will, if possible, collect additional samples for the full suite of analyses during the return trip through Lake Erie.

Figure 1. Plot of Turbidity versus Phosphorus (1983 to 2001) using mean station total phosphorus concentrations versus mean station turbidity



4.0 SEQUENCE OF SAMPLING EVENTS

The following is a brief summary of the sampling events. Some events may be done simultaneously and event order will be subject to conditions. Extra precautions should be taken with stations located in shipping lanes if sampling for an extended period of time (i.e., 24 hours).

4.1 Visual and Physical Station Observations

The Ship Operations contractor staff collect data for several physical and observation parameters at each station including:

Site Location	Station Depth
Air temperature	Visibility
Wind Speed	Wind Direction
Wave Height	Barometric Pressure
Weather Conditions	

4.2 Rosette Sampling

The Chief Scientist directs sample collection using the Rosette sampler in the following steps:

- 1) Run Rosette/CTD down to define the temperature profile and determine the thermal structure. During unstratified conditions that occur in the Spring, the sample depths are constant and are not dependent of the thermal structure (See Appendix B, Attachment A for a detailed list of monitoring stations and depths).
- 2) During stratified situations, the Chief Scientist or Shift Supervisor will examine the CTD profile. The Chief Scientist or Shift Supervisor and the Marine Technician will select sampling depths according to depth selection strategy for each lake (See LG 200, Section 5.0, Sample Depth Selection, for detailed information on selecting station depths).
- 3) Trigger sample bottle at correct depths, while verifying the temperature profile. (See Appendix B, Attachment A for a detailed list of monitoring stations and depths.)
- 4) Split Rosette Niskin samples into the required sample bottles/preservatives.
- 5) A composite (integrated) sample is taken for phytoplankton and chlorophyll a by compositing Niskin samples from the upper region of the water column. For an unstratified water column, the integrated sample is prepared by taking equal volumes of water from SRF (1 m), 5 m, 10 m and 20 meters unless the depth is less than 20 meters. If the total depth is between 15 and 22 meters, the 20 meter sample is replaced by the bottom sample (B1 or B2). If the total depth is less than 15 meters, equal volumes are taken from surface, mid-depth, and bottom sample (B1 or B2).

For a stratified water column, equal volumes are taken from the surface, 5 m, 10 m, and lower epilimnion (LEP). If the epilimnion is very shallow, equal volumes are taken from a maximum of four sampling depths and a minimum of two sampling depths. The underlying strategy is to collect a representative sample from the epilimnion.

4.3 Zooplankton Sampling

The Biology Chief Scientist directs the collection of zooplankton samples in the following sequence:

- 1) Conduct the 20 meter and B2 vertical tows for zooplankton samples

- 2) Rinse the net and pour into 500-mL polyethylene bottles and transfer the bottles to the onboard laboratory for preservation and storage.

4.4 Clarity Determination

After zooplankton tows have been completed, transparency measurements are made using Secchi disks.

Note: Secchi depth measurements are made only for tows performed during daylight hours (e.g., more than one hour after sunrise and more than one hour before sunset) and on the shady side of the boat, out of direct sunlight.

4.5 Benthos Sampling

The Biology Chief Scientist directs the collection of benthic invertebrate samples using the Ponar Grab device. Three Ponar grabs are collected in the Spring Survey and four Ponar grabs are collected in the Summer Survey.

4.6 Dissolved Oxygen (DO) Determination during the Lake Erie DO Surveys and Non-DO Surveys

DO measurements are collected using the SeaBird in all lakes during the Summer surveys. A full SeaBird profile is recorded for DO. Detailed procedures for operating the SeaBird can be found in Appendix D and also in SOP LG 200, *Standard Operating Procedure for Field Sampling Using the Rosette Sampler*. In addition for quality assurance purposes, one depth from approximately three predesignated stations will be collected and analyzed in duplicate by Winkler titration (see below). An additional DO survey is conducted in the central basin of Lake Erie. Refer to Appendix D, *Sampling and Analytical Procedures for GLNPO's Open Lake Water Quality Survey of the Great Lakes*, for DO and temperature profiles for this survey.

The Winkler determination is used for quality assurance purposes for the SeaBird determination of dissolved oxygen. It will be run in duplicate on one depth from approximately three predesignated stations per lake on the non-DO cruises. On the Lake Erie DO cruises, it will be performed in duplicate on the surface and the B- samples at each station. An oxygen saturated water sample will be analyzed by Winkler at least once per lake on the non-DO cruises and once per shift of the Lake Erie DO cruises. Analysis of these samples is made by the non-azide modification of the Winkler test.

5.0 SAMPLE INTEGRITY

- 5.1 Concentrations of chemicals in lake water are very dilute. A small amount of sample contamination can have a large effect on the results. Avoiding contamination is, therefore, a major quality control goal. To reduce contamination from atmospheric dust, empty bottles are capped during preparation for sampling. Care should also be taken in the storage of bottles to reduce exposure to "dirty" environmental conditions. During sampling, each bottle is rinsed with sample water, emptied, and filled with sample water. The cap is replaced after addition of the preservative, or immediately on samples that require no preservative. Transfer of the samples from one container to another or manipulations of the sample are avoided as much as possible because each such action can result in contamination. To reduce contamination and to control the volume of the preservatives, automatic pipettes or dispensers are used to dispense all preservatives.

6.0 DOCUMENT CONTROL AND SOP REVISIONS

- 6.1 In accordance with GLNPO's document and records control policy, this manual is a controlled document. In order to ensure that EPA, contractor, and grantee staff are using the current document, control copies of this manual are maintained by GLNPO's Document Control Coordinator. These control copies are maintained in **BLUE** binders and are labeled as control copies. Control copies of this document also are maintained by the Water Quality Monitoring and Indicator Branch Chief, the Monitoring Team Lead, the Quality Assurance

Manager, and the Ship Operations Contractor. Electronic copies are maintained by the GLNPO Quality Assurance Manager and GLNPO plans to include a copy on the GLNPO website at www.epa.gov/glnpo. Revisions to the SOPs in this document are made as follows:

- 1) Obtain a copy of the current SOP from a control copy of the manual,
- 2) Obtain the electronic copy from GLNPO's website at www.epa.gov/glnpo, if available, or from GLNPO's Quality Assurance Manager,
- 3) Revise the electronic copy of the SOP in Word Perfect using redline and strikeout (this will provide a record of the revisions) and prepare a clean copy of the revised SOP,
- 4) Update the revision number on the cover page and in the method footer,
- 5) Provide the two versions of the revised SOP (redline/strikeout version and the clean edited version) to the appropriate technical lead at GLNPO for review and approval.

Upon approval, the Technical Leads will provide the final revised SOP to the GLNPO Document Control Coordinator and the Quality Assurance Manager for inclusion in the control hard-copy and soft-copy of the manual.

7.0 STATION LOCATION CHANGE PROCEDURE

- 7.1 In the event that a station location needs to be changed (e.g., when the biology team searches for a depositional zone and would like to designate the coordinates of the new station location) certain steps should be followed to assure that the proposed change is approved, all participants are notified, and that all documentation are updated. Further, these steps will ensure that all documents, publications, and databases use the same finalized (current) station coordinates. The master list of station location coordinates will be posted on GLNPO's website, as well as in GLNPO's shared "Base Monitoring Program" directory.
- 7.2 To change a station location, the form *GLNPO's Base Monitoring Program Station Location Change Form*, located in Appendix Q, needs to be completed by filling in the following fields: station ID, old coordinates, new coordinates, new depth, the reason for the station location change, and the person's name who is requesting the change. The completed form should be submitted to the appropriate technical lead (Glenn Warren for open water stations and Marc Tuchman for benthos stations). Once the technical lead approves the change, he needs to sign and date the form.
- 7.3 The completed form needs to be initialed by GLNPO's Monitoring Team Leader to give final approval to the station location change, and then initialed by the Captain verifying that the ship's GPS unit has been updated. The form must then go to the GLENDA database manager who will initial it, file it, and update the master station location list. Before a new version of the SOP manual is released, these changes must be incorporated into the WQS QAPP and the Lake maps updated.
- 7.4 For consistency, new station location coordinates should be rounded to the nearest whole second of arc, decimal degrees should be limited to five significant digits, and decimal minutes should be limited to three significant digits.